CARBON SEQUESTRATION IN TEPETATES OF THE TEXCOCO RIVER BASIN, MEXICO

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INTRODUCTION: The *tepetates* are volcanic tuffs partially altered and hardened by geological and pedological processes. In the Neovolcanic Axis of Mexico the *tepetates* are found in the foothills and at different depths[1], in highly populated areas (*ca.* 30 000 km^2). When the soil covering the *tepetates* is eroded, they appear on the surface. These materials can be incorporated to agriculture by breaking up the hardened layers and the use of appropriate agricultural practices, since in their natural state they lack an ideal physical structure for crop production. Breaking up the substratum produces fragments of different sizes, with low C and N content[2], but no stable aggregates. The purpose of this paper was to study the impact of agricultural practices (time and quality) on the accumulation of C in cultivated *tepetates* and aggregation.

MATERIALS AND METHODS: One hundred plots of cultivated *tepetates* were sampled in the Texcoco River Basin, State of Mexico, representing nine agricultural managements and cultivation time periods from 0 to 100 years. Two compound soil samples per plot were collected to measure C (15 points, 0 to 20 cm) and to evaluate aggregates and fragments (5 points, 20 cm^3). The aggregates and fragments were separated into 14 fractions (>50.8, 50.8-31.7, 31.7-22.2, 22.2-11.5, 11.5-6.4, 6.4-4.8, 4.8-3.4, 3.4-2.0, 2.0-1.0, 1.0-0.46, 0.46-0.25, 0.25-0.10, 0.10-0.05, <0.05mm). The differentiation among fragments and aggregates was made manually, by using an arbitrary hardness scale (from weak to hard). The stability of aggregates in dryness and organic C were measured (Shimadzu TOC-5050^a automatic C Analyzer).

RESULTS AND DISCUSSION:. Agronomic management affected the concentration of C in the substratum, which was higher when using leguminous plants and addition of organic residues (Figure 1A)., C accumulated logarithmically or potentially in the substratum (Figure 1B) as the cultivation time was longer. In the cereal monoculture systems C accumulation was very limited. The accumulation rate of C during the first four years of cultivation went from 2.2 to 4.4 Mg ha^{-1} per year, depending on the agronomic management being used, and potentially more than 88 Mg ha^{-1} could be accumulated in few decades.

The percentage of aggregates in ameliorated *tepetates* increased logarithmically as the number of years under cultivation was greater. After 100 years *tepetates* may have more than 80% of aggregates, though **not all of** them are necessarily stable. They can accumulate up to three times more C than the fragments. The <0.25 mm particles accumulated more C than those larger in diameter. Carbon increased logarithmically or potentially as a result of the size reduction of particles (Fig. 1C). The cultivation systems sequestering more C are the intensive management greenhouses, which have perennial crops and where the substratum is not removed, and also those which organic fertilizers are added to and are combined or rotated with leguminous plants.

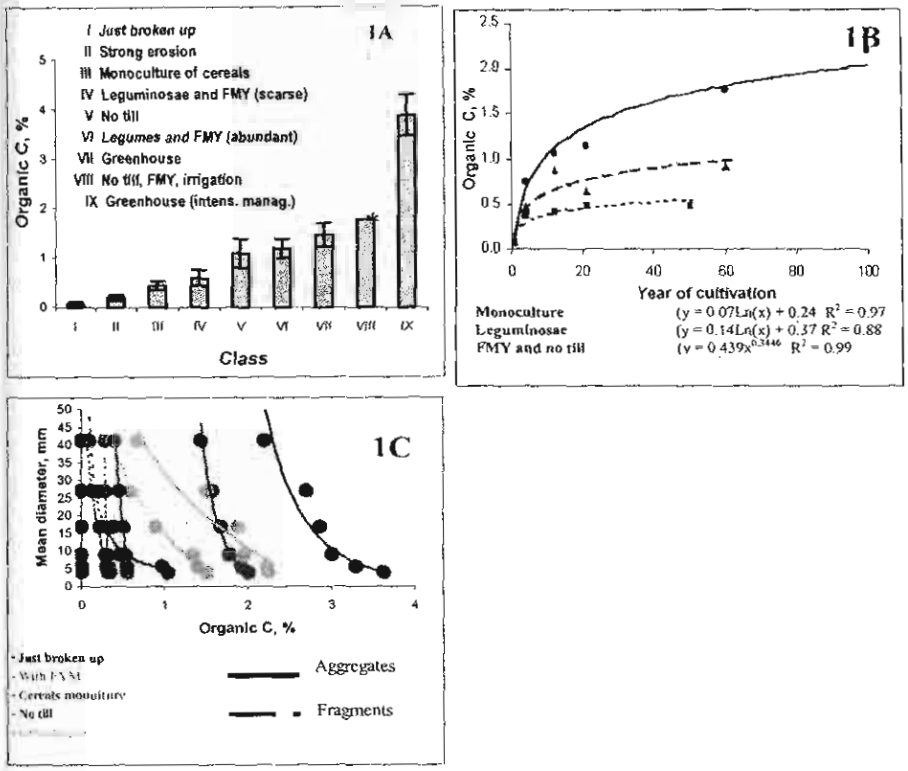

Figure 1A. Organic carbon in different cultivation systems. Figure 1B. Organic carbon and cultivation time period in three cultivation systems. Figure 1C. Organic carbon in different particle sizes in fragments and aggregates of cultivated tepetates.

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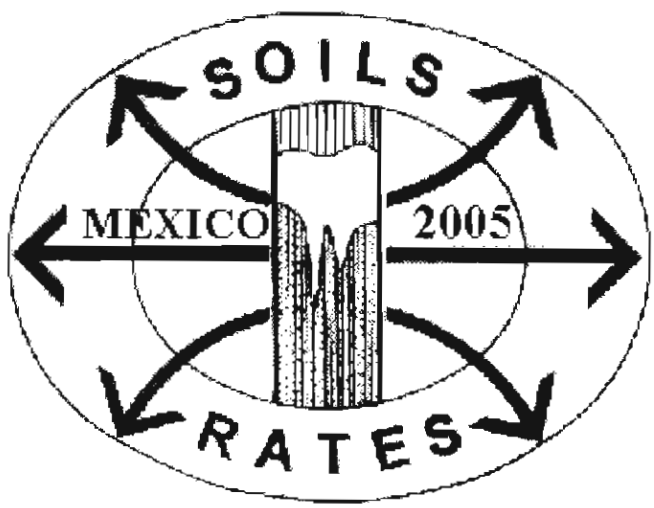

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